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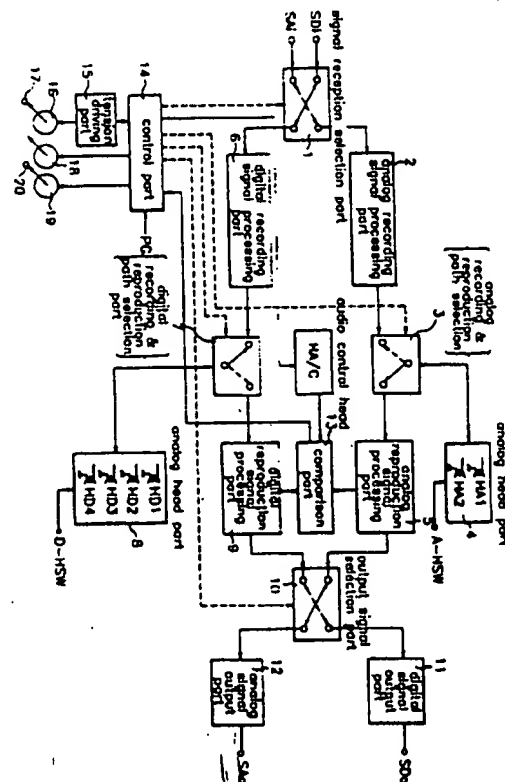
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54 **Analog-cum-digital video recording and reproducing device.**

57 Analog-cum-digital video recording and reproducing device which can perform recording and reproduction of HDTV digital signals as well as recording and reproduction of VHS analog signals.

The device having separate recording and reproduction processing systems for processing HDTV digital signals and VHS analog signals, and digital recording and reproduction heads and analog recording and reproduction heads, which can perform selective recording and reproduction of HDTV digital video signals and VHS analog video signals on or from a VHS tape by controlling running of the tape and rotation of the head drum to speeds appropriate to respective signal processing system, allows use of an existing VHS or S-VHS tape as it is for recording and reproduction of analog or digital video signals by providing means for interchanged reproduction of an existing VHS tape which allows recording of the high quality HDTV signals on a 1/2" VHS tape, can control the mode to be put into a digital recording mode or an analog recording mode at performing a recording according to the selection of a user, and can make automatic change over to a digital reproduction mode or an analog reproduction mode according to determination of kind of signals reproduced from a recorded tape at performing a reproduction, and can record and reproduce analog video signals and digital video signal into best quality images by mounting heads for analog signal band as well as heads for digital signal band on one head drum.



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According to a first aspect of the present invention there is provided an analog-cum-digital video recording and reproduction device, including a signal reception selection part for selecting video signals to be recorded from applied analog video signals and digital video signals, an analog recording signal processing part for processing analog video signals received from the signal reception selection part suitable to a recording format, an analog head part for reproduction of the analog video signals recorded on a video tape and recording the analog video signals received from the analog recording signal processing part, an analog recording and reproduction path selection part for applying the video signals processed at the analog recording signal processing part to the analog head part for recording, or transmitting the video signals reproduced at the analog head part, an analog reproduction signal processing part for processing the reproduced video signals selected at, and received from the analog recording and reproduction path selection part suitable to a reproduction format, a digital recording signal processing part for processing the digital video signals received from the signal reception selection part suitable to a recording format, a digital head part for reproduction of the digital video signals recorded on a video tape, and recording the digital video signals received from the digital recording signal processing part, a digital recording and reproduction path selection part for applying the video signals processed at the digital recording signal processing part to the digital head part for recording or transmitting the video signals reproduced at the digital head part, a digital reproduction signal processing part for processing the reproduced video signals selected at, and received from the digital recording and reproduction path selection part suitable to a reproduction format, an output signal selection part for selection and transmission of one signal of the signals received from the analog reproduction signal processing part and the digital reproduction signal processing part, an audio control head for recording and reproduction of audio and control signals on and from an audio tape, a comparison part for comparing the reproduced control signals received from the audio control head to the signals received from the analog reproduction signal processing part and the digital reproduction signal processing part, and a control part for controlling the signal reception selection part, the audio control head, the analog recording and reproduction path selection part, the digital recording and reproduction path selection part, the output signal selection part, the analog head part, and the digital head part in response to the signals received from the comparison part.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG.1 shows an entire system for an analog-cum-

digital video recording and reproduction device in accordance with an embodiment of the present invention.

FIG.2 is detail of a head drum for use in the system of Fig. 1.

FIG.3 shows phase angles and steps of the heads of FIG.2.

FIG.4a shows a recording format for recording digital signals on video tape in accordance with an embodiment of this invention.

FIG.4b shows a recording format for recording analog signals on video tape in accordance with an embodiment of this invention.

FIGs.5a-5o are signal wave patterns at the various parts in FIGs.1 and 2.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in FIG.1, an analog-cum-digital video recording and reproduction device in accordance with one embodiment of this invention includes a signal reception selection part 1, an analog recording signal processing part 2, an analog head part 4, an analog recording and reproduction path selection part 3, an analog reproduction signal processing part 5, a digital recording signal processing part 6, a digital head part 8, a digital recording and reproduction path selection part 7, a digital reproduction signal processing part 9, an output signal selection part 10, a digital signal output part 11, an analog signal output part 12, an audio control head 25, a comparison part 13, a control part 14, a tension driving part 15, a tension motor 16, a tension post 17, a drum motor 18, a capstan motor 19, and a capstan 20.

The signal reception selection part 1 selects a video signal to be recorded from the analog video signal SAI and the digital video signal SDI and applies the selected video signal to the analog recording signal processing part 2 or the digital recording signal processing part 6.

The analog recording signal processing part 2 processes the analog video signals received from the signal reception selection part 1 suitable to a recording format.

The analog head part 4 reproduces the analog video signals recorded on video tape and records the analog video signals received from the analog recording signal processing part 2.

The analog recording and reproduction path selection part 3 applies the video signals processed at the analog recording signal processing part 2 to the analog head part 4 for recording, or transmits the video signals reproduced at the analog head part 4.

The analog reproduction signal processing part 5 processes the reproduced video signals selected at, and received from the analog recording and reproduction path selection part 3 suitable to a reproduc-

duce digital video signals having great amount of information like the video signals of an HDTV.

And the analog heads HA1 and HA2 are composed of azimuth heads with azimuth angles of  $\pm 02$  of  $\pm 6$  deg. for interchanged recording and reproduction of VHS tape.

And, based on the signals generated by a phase generator mounted on the head drum 21, the control part 14 controls switching of the signal reception selection part 1, the analog recording and reproduction path selection part 3, the digital recording and reproduction path selection part 7, and the output signal selection part 10 for switching the heads HD1, HD2, HD3, HD4, HA1, and HA2.

Operation of the analog-cum-digital video recording and reproduction device in accordance with one embodiment of this invention is to be explained, hereinafter.

First, a case of recording digital signals is to be explained.

Upon application of an order for recording digital video signals, the control part 14, receiving the order, controls the system.

Upon receiving the order for recording the digital video signals, the control part 14 controls the signal reception selection part 1 to be switched to the digital signal SDi reception terminal, and controls the digital recording and reproduction path selection part 7 to be switched to the digital recording signal processing part 6.

And the control part 14 controls the capstan motor 19 to run the tape 22 via the capstan 20, and controls the drum motor 18 to rotate the drum 21 for making helical scan of the running tape 22.

And the digital signal SDi to be recorded is, applied to the digital recording signal processing part 6 through the signal reception selection part 1, and undergoes an initial amplification, modulation, and an equalizing amplification, and applied to the digital head part 8 for recording according to switching of the digital recording and reproduction path selection part 7.

Accordingly, the digital signal can be recorded on the tape 22 transferring in a speed  $Vt'$  by the capstan motor 19 and the capstan 20 in a pattern as shown in FIG.4a.

And, in this time, timing control signals CLT1 and CLT2 as shown in FIGs.5h and 5i are recorded on the tape 22 at a lower track 22T-A thereof through the audio control head 25 under the control of the control part 14.

Meantime, the head drum 21 driven by the drum motor 18 under the control of the control part 14 runs in 3600 rpm or 1800 rpm, and the speed  $Vt'$  of the tape 22 transferred by the capstan motor 19 and the capstan 20 is  $Vt' = Vt$  in case of 3600 rpm and  $Vt' = Vt/2$  in case of 1800 rpm.

Herein,  $Vt = 33.35$  mm/sec, being the VHS stan-

dard transfer speed.

Referring to FIG.4a, a digital recording pattern formed on the tape 22 based on the standard layout of the heads shown in FIGs.2 and 3 has inclined tracks 22A, 22B, 22C, and 22D with an azimuth angle of  $+15$  deg. and a fixed track pitch ( $Tp = 14.5 \mu m$ ) per one revolution, the timing control signal CLT1 as shown in FIG.5h in case running speed of the tape 22  $Vt' = Vt$  and the timing control signal CLT2 shown in FIG.5i in case running speed of the tape 22  $Vt' = Vt/2$  at the lower track 22T-A thereof, and audio signals at a upper track 22T-B thereof as required.

The upper track 22T-A for audio signals may not be required since the digital signal can be a signal containing entire signals of the video signal and the audio signal, but it is provided for the cases when desired to record audio signals using the audio control head 25 on it as an extra.

And, since the tension on the video tape 22 can vary depending on both the rotation speed of the head drum 21 and the transferring speed of the tape 22, the control part 14 controls the tension driving part 15 to drive the tension post 17 through the tension motor 16 for adjusting the tension on the tape 22 to suit to the speed of the tape 22 and the drum 21.

Second, a case of recording analog signals is to be explained.

Upon application of an order for recording an analog video signal, the control part 14, receiving the order, controls the system.

Upon receiving the order for recording the analog video signal, the control part 14 controls the signal reception selection part 1 to be switched to the analog signal SAi reception terminal, and controls the analog recording and reproduction path selection part 3 to be switched to the analog recording signal processing part 2.

And the control part 14 controls the capstan motor 19 to run the tape 22 via the capstan 20, and controls the drum motor 18 to rotate the drum 21 for making helical scan of the running tape 22.

And the analog signal SAi to be recorded is, applied to the analog recording signal processing part 2 through the signal reception selection part 1, and undergoes an initial amplification, modulation, and an equalizing amplification, and applied to the analog head part 4 for recording according to switching of the analog recording and reproduction path selection part 3.

Accordingly, the analog signal can be recorded on the tape 22 transferring in a speed  $Vt$  by the capstan motor 19 and the capstan 20 in a pattern shown in FIG.4b.

And, in this time, the timing control signal CLT2 as shown in FIG.5i is recorded on the tape 22 at the lower track 22T-A thereof through the audio control head 25 under the control of the control part 14.

Meantime, the head drum 21 driven by the drum

the output signal of the phase generator has an earlier phase than the digital head HD1 by a predetermined time period t2 and has an earlier phase than the analog head HA1 by a predetermined time period t3.

Therefore, when the timing of the output signal of the phase generator is as shown in FIG.5c, the control part 14, by applying head switching signals D-SW as shown in FIGs.5a and 5b to the digital head part 8, switches the digital heads HD1 and HD3, and HD2 and HD4 with head switching signals D-HSW1 and D-HSW2.

Accordingly, the outputs of the signals reproduced at the digital heads HD1 and HD3, and HD2 and HD4 switched by head switching signals D-HSW1 and D-HSW2 as shown in FIGs.5a and 5b have wave patterns and timings as shown in FIGs.5j and 5k, and the outputs of the reproduced signals are, processed at the digital reproduction signal processing part 9, and applied to the digital signal output part 11 through the output signal selection part 10 for being processed suitable for displaying on the monitor.

Meantime, in case the phase generator has a timing as shown in FIG.5f, the control part 14 determines whether it is a reproduction for a reproduction signal at a drum speed of 3600 rpm or at a drum speed of 1800 rpm by determining the timing of the control signal reproduced from the audio control head 25 being FIG.5h or FIG.5i.

That is, if the timing of the control signal at digital reproduction is as shown in FIG.5h, understanding that it is a case of 3600 rpm at  $V_t' = V_t$  reproduction, by switching the digital heads HD1 and HD3, and HD2 and HD4 with the head switching signals D-HSW1 and D-HSW2 having timings as shown in FIGs.5a and 5b, and if the timing of the control signal at digital reproduction is as shown in FIG.5i, understanding that it is a case of 1800 rpm at  $V_t' = V_t/2$  reproduction, by switching the digital heads HD1 and HD3, and HD2 and HD4 with the head switching signals D-HSW1/2 and D-HSW2/2 having timings as shown in FIGs.5d and 5e, a reproduction head switching appropriate to a recorded speed can be done.

On the other hand, in case the control part 14 determines that it is an analog reproduction based on the detection signal of the comparison part 13, and controls switching of the analog recording and reproduction path selection part 3, the digital recording and reproduction path selection part 7, and the output signal selection part 10 for applying the video signal reproduced from the analog head part 4 to the analog reproduction signal processing part 5, the control signal reproduced from the audio control head 25 will be pulses having a timing as shown in FIG.5i, and the control part 14, receiving such a signal accordingly, carries out head switching by applying a head switching signal A-HSW3 having a timing as shown in FIG.5g to the analog heads HA1 and HA2 as head switching signals.

The video signals reproduced at the analog heads HA1 and HA2 through the foregoing head switching control have wave patterns as shown in FIGs.5l and 5m, and these analog signals are, processed with the same process as the foregoing process at the analog reproduction signal processing part 5, and applied to the analog signal output part 12 through the output signal selection part 10.

The analog signal output part 12, accordingly, presents the signals after processing the received analog video signals into analog signals suitable for displaying on the monitor.

It can be seen from the foregoing that the described embodiment has following advantages.

First, since two cases of control signal selection for recording on tape as shown in FIGs.5h and 5i is made available at recording and reproduction of HDTV video signals, the time period required for recording and reproduction can be extended to maximum two times, i.e., up to four hours, with the tape transferring speed kept the same with the conventional VHS tape standard transferring speed of 33.35 mm/sec (two hours of standard reproduction time period) or with 1/2 of the standard speed of 16.675 mm/sec.

Second, since a VHS interchanged recording and reproduction is made available by devising that digital signals and analog signal can be recorded and reproduced using the same head drum, and analog signals can be recorded and reproduced in a pattern identical to the existing VHS recording pattern, this system can be applicable to an existing VHS tape.

Although the invention has been described in conjunction with specific embodiments, it is evident that many alternatives and variations will be apparent to those skilled in the art in light of the foregoing description. Accordingly, the invention is intended to embrace all of the alternatives and variations that fall within the scope of the appended claims.

## Claims

1. An analog-cum-digital video recording and reproduction device, comprising:
  - a signal reception selection part for selecting video signals to be recorded from applied analog video signals and digital video signals;
  - an analog recording signal processing part for processing analog video signals received from the signal reception selection part suitable to a recording format;
  - an analog head part for reproduction of the analog video signals recorded on a video tape and recording the analog video signals received from the analog recording signal processing part;
  - an analog recording and reproduction path selection part for applying the video signals proc-

FIG. 1

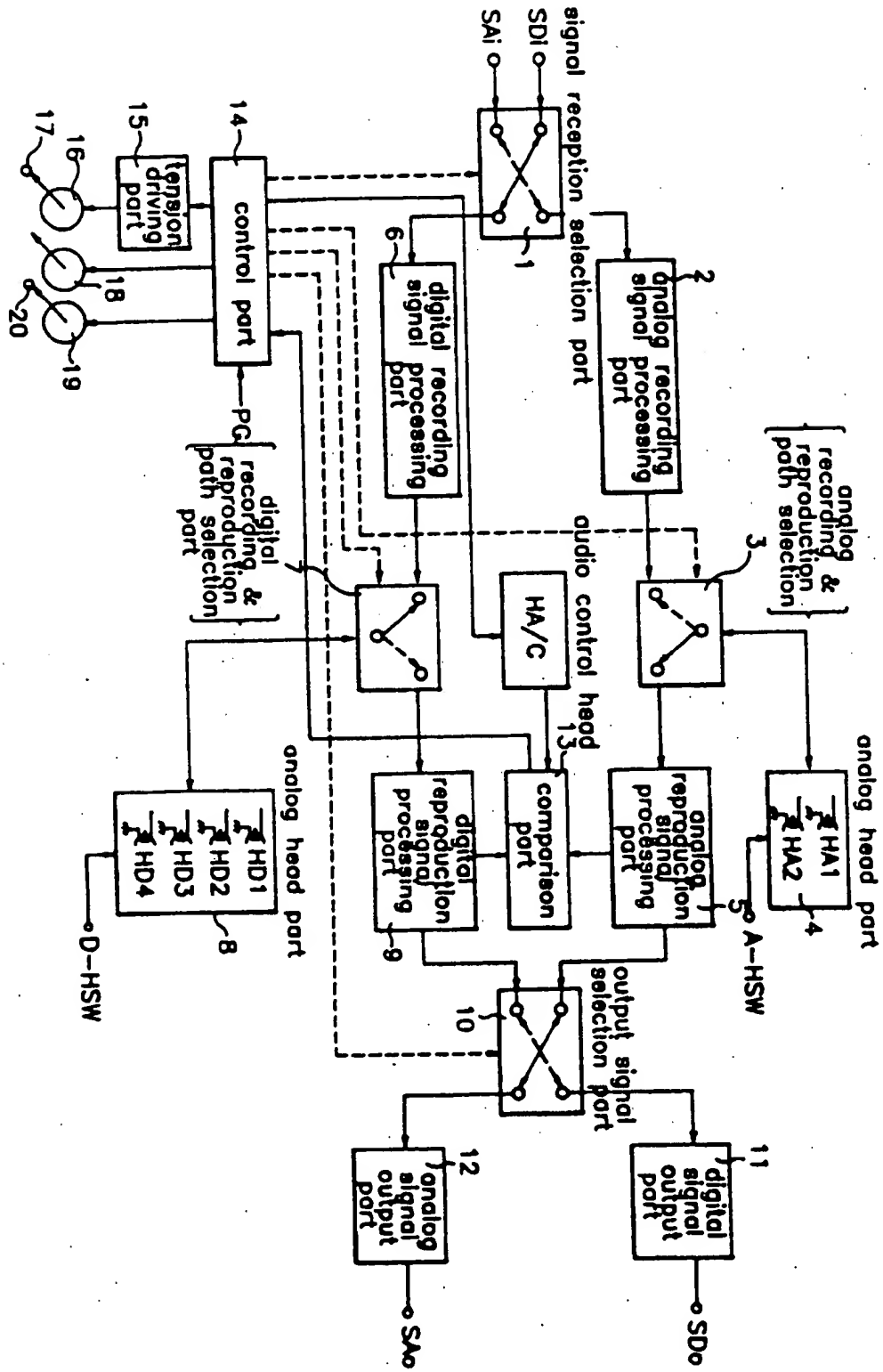


FIG.4a

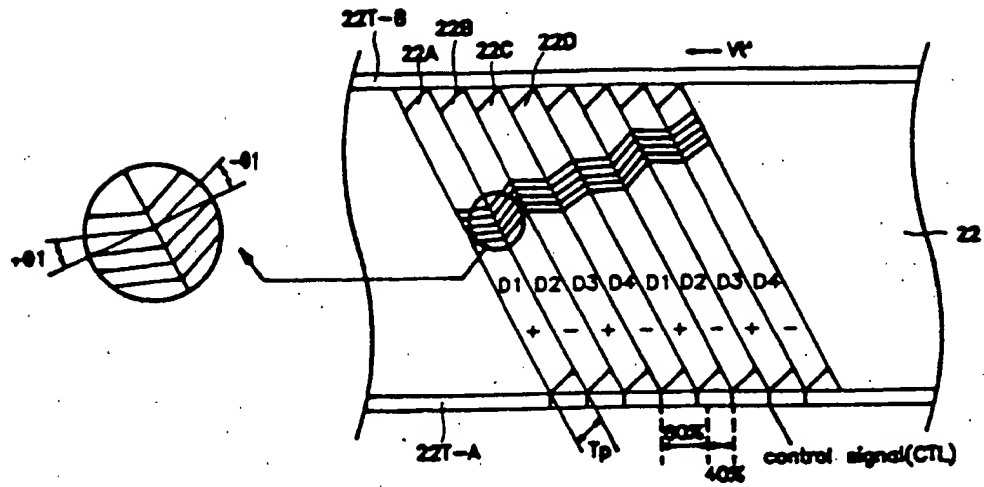
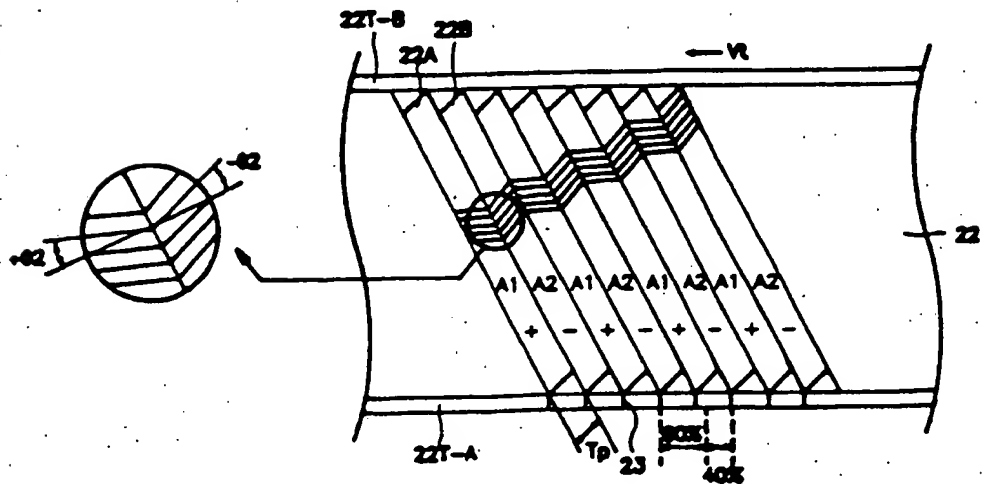


FIG.4b





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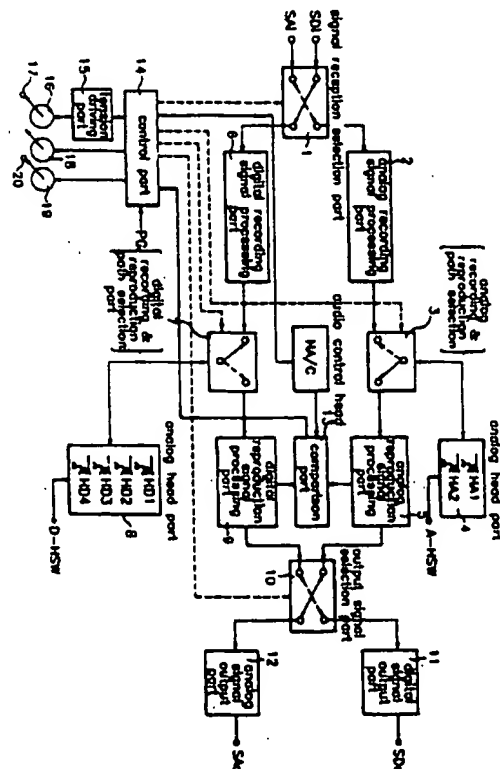
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⑤④ **Analog-cum-digital video recording and reproducing device**

⑤⑦ **Analog-cum-digital video recording and reproducing device which can perform recording and reproduction of HDTV digital signals as well as recording and reproduction of VHS analog signals.**

The device having separate recording and reproduction processing systems for processing HDTV digital signals and VHS analog signals, and digital recording and reproduction heads and analog recording and reproduction heads, which can perform selective recording and reproduction of HDTV digital video signals and VHS analog video signals on or from a VHS tape by controlling running of the tape and rotation of the head drum to speeds appropriate to respective signal processing system, allows use of an existing VHS or S-VHS tape as it is for recording and reproduction of analog or digital video signals by providing means for interchanged reproduction of an existing VHS tape which allows recording of the high quality HDTV signals on a 1/2" VHS tape, can control the mode to be put into a digital recording mode or an analog recording mode at performing a recording according to the selection of a user, and can make automatic change over to a digital reproduction mode or an analog reproduction mode according to determination of kind of signals reproduced from a recorded tape at performing a reproduction, and can record and reproduce analog video signals and digital video signal into best quality images by mounting heads for analog signal band as well as heads for digital signal band on one head drum.



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